1 m. long, 0.5 m. broad, the median and upper leaves a little larger, 1.5 mm. long, 0.5–0.6 mm. broad, not decurrent at base, ovate or ovate-oblong, short acuminate, narrowly decurrent from base to apex, denticulate above, costa strong, reddish, 60–65μ thick at base, short excurrent in the middle and upper leaves, hardly percurrent in the lower; median and upper cells short-hexagonal, 30–35μ long, 12μ broad, with incrassate walls, marginal cells linear in two or three rows, lower cells larger, laxer, rectangular, 35-50μ long, 12–18μ broad. Capsule oblong, 4–4.5 mm. long, 1–2 mm. broad, nodding or perdulous, neck abruptly contracted when moist; operculum convex-apiculate. Seta elongated, flexuous, reddish, 4–6 cm. long. Annulus broad. Teeth of peristome narrow, pale, reddish above with 18–22 lamellæ, 0.35-0.4 mm. long, 50μ broad at base, basal membrane of the inner peristome adherent ⅓ the height of the teeth, segments linear, gaping along the keel; cilia very short or none. Spores minute, pale, 12μ in diameter. Plate XXI.

Nevada: Spooner, Douglas Co., in large mats on moist banks (C. F. Baker, 1902).

This moss can be placed near *B. longisetum* Bland., but it is easily distinguished from it by the numerous sterile branches arising from below the perichaetium, the smaller leaves with a shorter acumen, the peristomial teeth, which are narrower and paler, and have more numerous lamellæ, and finally the much smaller spores.

(To be Continued.)

WHAT TO NOTE IN THE MACROSCOPIC STUDY OF LICHENS.

BRUCE FINK.

INTRODUCTORY STATEMENT.

Mrs. Carolyn W. Harris has, in previous volumes of the BRYOLOGIST, given amateur lichenists a series of descriptions of the more conspicuous lichen species, which will prove helpful to workers in determinations and in fixing the main features of gross morphology. It is the purpose of the present paper to state the principal features of gross morphology, including not only the foliose and fruticose lichens, but also extending the statement to the most inconspicuous crustose species as well. In so doing, we shall confine attention to such elements of structure as may readily be seen with the unaided eye or with an ordinary hand-lens.

THE THALLUS.

In this study, it is but natural to begin with the vegetative tract of the lichen—the thallus. The thallus may be an erect structure, rising from the substratum; a pendulous one, hanging downward from it; a conspicuous or inconspicuous flat one, closely or loosely attached to the substratum: or an inconspicuous one, largely or even wholly imbedded in the substratum. Erect and pendulous forms are commonly called fruticose thalli, and the flat or horizontal ones may be either foliose, or crustose; foliose when somewhat leaf-like, and crustose when a closely attached crust resting on or within the substratum.

General Forms of Thalli.

Here we may consider such characters of the three types of thalli as may be readily seen. Beginning with the foliose forms, which the student will be likely to observe first, it will be readily noticed in comparing a number of them that they are variously lobed, or that some are quite entire at the margin. In instances where the lobing is evident, the lobes may be more or less imbricated. In both lobed and unlobed forms the margin may be wavy or crenate instead of entire, and it may be ciliate or devoid of cilia.

Passing to the fruticose thalli, which are quite as likely to attract attention, one would notice first of all whether branched or unbranched, and the manner of branching. Then attention would be attracted to the surface, and one would readily observe that in some there are small outgrowths from the main axes, other than the branches. These are flat expanses in the *Cladonias*, and called squamules. In the *Stereocalons*, these outgrowths are more irregular in form, and are known as phyllocladia.

In the crustose thalli, one would note with the eye, as a rule, simply a more or less conspicuous crust spread over the substratum, or sometimes really lying wholly or partly in the substratum, and indicated at the surface often only by a change in color. These crustose thalli will be found irregular in outline or more or less plainly orbicular, and to form a continuous or more or less broken and scattered crust. In some species the tendency is toward more orbicular forms, and in others more toward irregularity in form; but in any case, the peculiarities of the surface of bark, dead wood or rock forming the substratum will determine the form of the particular thallus to a large extent.

Lichens are a late evolution, and the forms are still quite plastic. Nevertheless, the forms, sizes and colors of lichen species are quite as constant as in many undoubted autonomies, whether plant or animal. Indeed, in many lichens the morphological characters, whether gross or minute, are quite as constant as are those of most flowering plants, and it may well be doubted whether even the *Cladonias* are very much more plastic than the members of the genus *Craetegus*, including our common hawthorns.

Sizes of Thalli.

Having disposed of the matter of forms and positions of lichen thalli, some words are in order regarding sizes. The measurements are all given in this paper in units of the metric system, and fruticose thalli of *Usnea longissima* frequently reach 1.5 metres in length, while the foliose thalli of *Gyrophora Dillenii* sometimes reach .35 of a meter in diameter. To simplify somewhat, strands of the *Usnea* five feet long have been carefully picked out of the tangled masses hanging over the branches of trees, and specimens of the *Gyrophora* and another species of the genus have been measured which surpassed one foot across the longer way of the thallus. Both fruticose and foliose thalli may vary in size from these large forms to minute ones not more than .2 mm. in height or diameter. In the crustose thalli, we most naturally think of the spread over or within the substratum, and this may vary greatly, though the spread is seldom more than 10 cm. In these

and the fruticose forms, the thickness is to be taken into account. But in the descriptions, actual measurements of thickness are very seldom given, though comparative statements are often resorted to. In the descriptions of the fruticose forms the diameter of the thallus, or branches of it are often given; and here again is a considerable amount of variation found, though very much less than that of length or distance across the thalli.

The Surfaces of Thalli.

After noting the size and form of the thallus the observer would naturally turn to the surface and note its general character. First, in the foliose thalli, he would note whether the upper surface is comparatively smooth or wrinkled, corrugate or pustulate; whether it bears cilia or the minute growths known as isidioid branchlets, and whether it is sorediate or not. Also, now, if not before, he must notice whether the margin of the thallus is closely attached to the substratum, or more or less ascendant. Then turning to the lower surface, it will commonly be found that it is more or less covered with the attaching organs known as rhizoids. It must be noticed whether these are large or small, whether numerous or few, and whether evenly scattered or collected into rows or in groups or other forms. Then, too, the lower surface is sometimes quite smooth, except for these rhizoids, but in other instances it will be found to be variously wrinkled or pitted, or in *Gyrophoras*, bearing vertical plates which gives strength.

In the fruticose thalli, one will find the surface smooth or more or less pitted, and in some instances it is somewhat tomentose. Then, in the *Stereocaulons*, one will find the peculiar structure known as phyllocladia, and in the *Cladonias*, the squamules. The form, size, frequency of occurrence and distribution of these organs must be noted carefully. And in the *Cladonias* especially, it is necessary to note whether the cortex of the podetium is entire or more or less broken so that it becomes areolate or even disappears over some portion of the podetium. And in this same genus, careful observation with a lens is necessary to ascertain whether any part of the fruticose portion of the thallus is sorediate or not.

Finally, turning to the crustose thalli, they are also smooth or variously roughened. Those that are hypophloeodal or hypolithic simply take the contour of the surface of the substratum as do also some thin and smooth forms that are in part or wholly epiphloeodal or epilithic. Others are scurfy or granular, and these are usually rather poorly developed and thin. In thicker forms we are likely to find the warty or verrucose condition, and here and there may occur minute chinks, so that the thallus is said to be rimose or chinky, or finally the chinks may become numerous and divide the thallus into minute or small several sided areas known as areoles. Such a thallus is said to be areolate.

Colors of Thalli.

As compared with size and form, color is usually regarded as a rather more variable and therefore less reliable taxonomic character. Yet the colors of thalli play quite an important part in determining lichens, and though often quite variable, they must be carefully noted. Colors in lichen thalli

vary all the way from a white to a black, but what we will call sea-green is the most common color. This color is a greenish-gray. Some other colors are ashy, olivaceous, brown, straw-color and various intermediate conditions as brownish-black and olive-brown, etc. And the thallus is often more or less variegated, while the lower surface is frequently of a different color from the upper. Also, in the fruticose forms the basal portion is frequently of a different color than the distal portions, usually darker. The tendency of thalli, as other lichen structures, is to darken with age, and the variations in a species may usually be traced to peculiar conditions of growth, through no very definite studies of this matter have been made. Grinnell, Iowa.

(To be Continued.)

SULLIVANT MOSS CHAPTER NOTES.

The following names have been added to list of Chapter Members since May 1st, making total number one hundred and forty-nine: Mr. William L. Sherwood, 36 Washington Place, New York City. Rev. W. W. Watts, "The Manse," Young, New South Wales, Australia.

NOTE TO MEMBERS.

It has been a great regret to me that my illness and long convalescence has prevented me from determining lichens for the members of the Sullivant Moss Chapter. As I do not expect for another year to be able to do this work, Mr. Merrill has kindly consented, not only to determine Cladonias for Chapter Members, but any lichens sent to him, "providing ample specimens with full data are sent."

Mr. Merrill's address is G. K. Merrill, 564 Main street, Rockland, Maine.

The interest in the study of the Lichens seems to be increasing, and with the help given by the excellent articles published in THE BRYOLOGIST, the students ought to increase in number as well as in knowledge of these very interesting plants.

With grateful acknowledgement of the many kind messages sent me by the Chapter Members during my illness, I am, cordially,

CAROLYN W. HARRIS.

OFFERINGS.

(To Chapter Members only. For postage.)

Mr. J. W. Huntington, Amesbury, Mass. *Dicranum Bergeri*, Bland., c.fr.; *D. montanum*, Hedw., st. Collected in Amesbury. *Dicranum spurium* Hedw., st. Collected in Weare, N. H.

Mr. B. D. Gilbert, Clayville, Oneida Co., N. Y. *Camptothecium nitens* Schimp., st.; *Fissidens taxifolius* (L.) Hedw., c.fr. Collected in Clayville. (A stamp is preferred to an addressed envelope).

Mrs. Augustus P. Taylor, Thomasville, Ga. *Ditrichum pallidum* (Schreb.) Hampe.. c.fr.; *Fissidens polypodioides* Hedw., c.fr. Collected in Thomasville.

Miss Caroline C. Haynes 16 East 36th street, New York City. *Blepharostoma trichophyllum* (L.) Dumort.; *Porella platyphylla* (L.) Lindb. Collected in the southwestern Adirondack Mts., N. Y.

Mrs. R. H. Carter, 37 Church street, Laconia, N. H. *Usnea barbata* (L.) Fr. var. *rubiginea* Michx. Collected in Laconia. *Evernia vulpina* (L.) Ach. Collected in Oregon.

Mrs. Carolyn W. Harris, Chilson Lake, Essex Co., New York. *Solorina saccata* (L.) Ach. Collected Chilson Lake.